# TOPIC 09 — REDOX

# 9.3 — REACTIVITY

IB Chemistry

T09D02

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# 9.3 – Reactivity

- 9.3.1 Deduce a reactivity series based on the chemical behavior of a group of oxidizing and reducing agents. (3)
- 9.3.2 Deduce the feasibility of a redox reaction from a given reactivity series. (3)

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# Reactivity Series

9.3.1 Deduce a reactivity series based on the chemical behavior of a group of oxidizing and reducing agents. (3)

- Metals act as reducing agents (meaning they are oxidized)
- More reactive metals are more easily oxidized as metals desire to lose electrons and therefore the most reactive will be able to achieve this
- Metals can be tested against one another in **Single Replacement Reactions**
- For Example, the replacement of $Cu^{2+}$ by Mg
  - $Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$
  - $Mg(s) + Cu^{2+}(aq) + SO_4^{2-}(aq) \rightarrow Mg^{2+} + SO_4^{2-}(aq) + Cu(s)$
  - $Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+} + Cu(s)$
    - $Mg(s) \rightarrow Mg^{2+} + 2e^-$
    - $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

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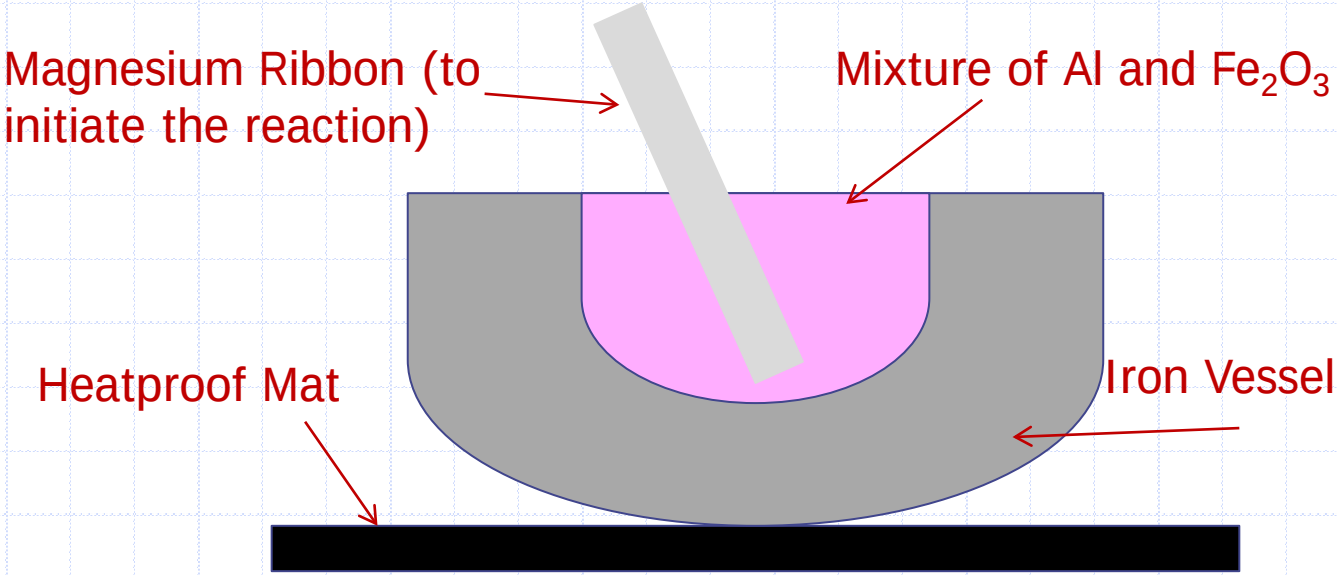
# Thermite Reactions

- Reactions can also be carried out in the solid state but are much more rare.
- This example is known as a thermite reaction
  - $Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe(l) + Al_2O_3(s)$
- This reaction occurs because aluminum is a more powerful reducing agent than iron



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# Reactions in Water

- When we react some metals in water, we find the ½ reaction of water
- The reaction between sodium and water is as follows:
  - $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$
  - Half Reactions:
    - $2Na(s) \rightarrow 2Na^+(aq) + 2e^-$
    - $2H_2O(l) + 2e^- \rightarrow 2OH^-(aq) + H_2(g)$
- Each of the alkali metals will react just as above

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# Predictions

## 9.3.2 Deduce the feasibility of a redox reaction from a given reactivity series.

- In your data booklet you will find a list of reduction potentials. The materials at the top are the best reducing agents and therefore more easily oxidized themselves.

### 14. Standard electrode potentials

| Oxidized species | ⇌ | Reduced species | $E^{\ominus}$ / V |
|---|---|---|---|
| $Li^+(aq) + e^-$ | ⇌ | $Li(s)$ | −3.04 |
| $K^+(aq) + e^-$ | ⇌ | $K(s)$ | −2.93 |
| $Ca^{2+}(aq) + 2e^-$ | ⇌ | $Ca(s)$ | −2.87 |
| $Na^+(aq) + e^-$ | ⇌ | $Na(s)$ | −2.71 |
| $Mg^{2+}(aq) + 2e^-$ | ⇌ | $Mg(s)$ | −2.37 |
| $Al^{3+}(aq) + 3e^-$ | ⇌ | $Al(s)$ | −1.66 |
| $Mn^{2+}(aq) + 2e^-$ | ⇌ | $Mn(s)$ | −1.19 |
| $H_2O(l) + e^-$ | ⇌ | $\frac{1}{2}H_2(g) + OH^-(aq)$ | −0.83 |
| $Zn^{2+}(aq) + 2e^-$ | ⇌ | $Zn(s)$ | −0.76 |
| $Fe^{2+}(aq) + 2e^-$ | ⇌ | $Fe(s)$ | −0.45 |
| $Ni^{2+}(aq) + 2e^-$ | ⇌ | $Ni(s)$ | −0.26 |
| $Sn^{2+}(aq) + 2e^-$ | ⇌ | $Sn(s)$ | −0.14 |
| $Pb^{2+}(aq) + 2e^-$ | ⇌ | $Pb(s)$ | −0.13 |
| $H^+(aq) + e^-$ | ⇌ | $\frac{1}{2}H_2(g)$ | 0.00 |
| $Cu^{2+}(aq) + e^-$ | ⇌ | $Cu^+(aq)$ | +0.15 |